

WHAT IS CLAIMED IS:

1                   1. A tire monitoring apparatus for mounting on a vehicle wheel that  
2 is configured to have a tire mounted thereon, the wheel having a first opening, the  
3 apparatus comprising:  
4                   a tire monitor for monitoring a tire parameter, the tire monitor having  
5 a housing with a spherical surface, the housing further having a second opening that  
6 extends through the spherical surface;  
7                   a tire valve stem that is configured to extend through the first and  
8 second openings, the valve stem having a threaded portion; and  
9                   a threaded fastener that is engageable with the threaded portion of the  
10 valve stem for attaching together the tire monitor and the valve stem, the fastener  
11 having a spherical surface that engages the spherical surface of the housing when the  
12 fastener is engaged with the threaded portion of the valve stem.

1                   2. The apparatus of claim 1 wherein the fastener has a base portion  
2 and multiple spaced apart projections extending from the base portion, each  
3 projection having a spherical surface that is engageable with the spherical surface  
4 of the housing when the fastener is engaged with the threaded portion of the valve  
5 stem.

1                   3. The apparatus of claim 2 wherein the multiple spaced apart  
2 projections include three projections.

1                   4. The apparatus of claim 2 wherein the multiple spaced apart  
2 projections include four projections.

1                   5. The apparatus of claim 2 wherein the projections cooperate to  
2 provide at least three points of contact with the spherical surface of the housing  
3 when the fastener is engaged with the threaded portion of the valve stem.

1                   6. The apparatus of claim 5 wherein the points of contact lie  
2 generally in a plane that is generally perpendicular to an axis extending through the

3 fastener and the valve stem when the fastener is engaged with the threaded portion  
4 of the valve stem.

1 7. The apparatus of claim 1 wherein the fastener includes a base  
2 portion having first and second ends, multiple spaced apart first projections  
3 extending from the first end of the base portion, and multiple spaced apart second  
4 projections extending from the second end of the base portion, each projection  
5 having a spherical surface, the spherical surfaces of the first projections being  
6 engageable with the spherical surface of the housing when the first end of the base  
7 portion of the fastener is facing toward the spherical surface of the housing and the  
8 fastener is engaged with the threaded portion of the valve stem, the spherical  
9 surfaces of the second projections being engageable with the spherical surface of the  
10 housing when the second end of the base portion of the fastener is facing toward the  
11 spherical surface of the housing and the fastener is engaged with the threaded  
12 portion of the valve stem.

1 8. The apparatus of claim 7 wherein the fastener includes three first  
2 projections and three second projections.

1 9. The apparatus of claim 7 wherein the fastener includes four first  
2 projections and four second projections.

1 10. The apparatus of claim 7 wherein the first projections cooperate  
2 to provide at least three points of contact with the spherical surface of the housing  
3 when the first end of the base portion of the fastener is facing toward the spherical  
4 surface of the housing and the fastener is engaged with the threaded portion of the  
5 valve stem.

1 11. The apparatus of claim 10 wherein the points of contact lie  
2 generally in a plane that is generally perpendicular to an axis extending through the  
3 fastener and the valve stem when the fastener is engaged with the threaded portion  
4 of the valve stem.

1                   12. A tire monitoring apparatus for mounting on a vehicle wheel that  
2 is configured to have a tire mounted thereon, the wheel having a first opening, the  
3 apparatus comprising:

4                   a tire monitor for sensing pressure in the tire, the tire monitor having  
5 a housing with a spherical surface, the housing further having a second opening that  
6 extends through the spherical surface;

7                   a tire inflator valve assembly that is configured to extend through the  
8 first and second openings, the valve assembly having a longitudinal axis and a  
9 threaded portion; and

10                  a threaded fastener that is engageable with the threaded portion of the  
11 valve assembly for attaching together the tire monitor and the valve assembly, the  
12 fastener including a base portion having first and second ends, the fastener further  
13 including multiple spaced apart first projections extending from the first end of the  
14 base portion, and multiple spaced apart second projections extending from the  
15 second end of the base portion, each projection having a spherical surface, wherein  
16 the spherical surfaces of the first projections are configured to provide at least three  
17 first points of contact with the spherical surface of the housing when the first end  
18 of the base portion of the fastener is facing toward the spherical surface of the  
19 housing and the fastener is engaged with the threaded portion of the valve assembly,  
20 such that the first points of contact lie generally in a plane that is generally  
21 perpendicular to the axis of the valve assembly, and wherein the spherical surfaces  
22 of the second projections are configured to provide at least three second points of  
23 contact with the spherical surface of the housing when the second end of the base  
24 portion of the fastener is facing toward the spherical surface of the housing and the  
25 fastener is engaged with the threaded portion of the valve assembly, such that the  
26 second points of contact lie generally in a plane that is generally perpendicular to the  
27 axis of the valve assembly.

1                   13. A tire monitoring apparatus for mounting on a vehicle wheel that  
2 is configured to have a tire mounted thereon, the wheel having a first opening, the  
3 apparatus comprising:

4                   a tire monitor for monitoring a tire parameter, the tire monitor having  
5 a housing with a spherical surface, the housing further having a second opening that  
6 extends through the spherical surface;

7                   a tire valve stem that is configured to extend through the first and  
8 second openings, the valve stem having a threaded portion; and

9                   a threaded fastener that is engageable with the threaded portion of the  
10 valve stem and the spherical surface of the housing for attaching together the tire  
11 monitor and the valve stem, the fastener having a configuration that provides at least  
12 three points of contact with the spherical surface of the housing when the fastener  
13 is engaged with the spherical surface of the housing.

1                   14. The apparatus of claim 13 wherein the fastener has at least three  
2 engaging members that are engageable with the spherical surface of the housing to  
3 provide the at least three points of contact.

1                   15. The apparatus of claim 14 wherein each engaging member has  
2 a spherical surface that is engageable with the spherical surface of the housing.

1                   16. The apparatus of claim 14 wherein each engaging member has  
2 a conical surface that is engageable with the spherical surface of the housing.

1                   17. The apparatus of claim 14 wherein each engaging member has  
2 a substantially flat surface that is engageable with the spherical surface of the  
3 housing.